

Before the  
**Federal Communications Commission**  
Washington DC 20554

In the Matter of

Carrier Current Systems, Including  
Broadband over Power Line Systems

ET Docket No. 03-104

Amendment of Part 15 Regarding New  
Requirements and Measurement Guidelines  
for Access Broadband over Power Line  
Systems

ET Docket No. 04-37

**REPLY COMMENTS OF CURRENT TECHNOLOGIES, LLC**

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## **TABLE OF CONTENTS**

A.	Summary .....	1
B.	BPL is in the Public Interest. ....	6
C.	Properly Designed BPL Is Fully Compatible with Licenced Spectrum Use. ....	10
1.	NTIA finds that application of BPL standards will reduce power line noise. ....	13
2.	Power lines do not radiate Current Technologies' BPL signals. ....	13
3.	Current Technologies' emissions do not aggregate harmfully. ....	15
4.	Power lines cannot generate noncompliant harmonics and intermodulation products from BPL signals. ....	16
5.	Impedance discontinuities cannot add significantly to BPL emissions. ....	17
6.	Skywave propagation is not a significant factor in interference. ....	17
7.	NTIA's interference findings do not apply to Current Technologies' implementation. ....	18
D.	The Commission's Mitigation Proposals Can Fully Protect Other Users Without Unduly Burdening BPL. ....	20
1.	Mitigation response times .....	22
2.	Mitigation methods .....	25
3.	Notice to BPL customers .....	26
4.	Database considerations .....	27
5.	No advance coordination .....	29

E.	NTIA's Proposed Interference Prevention Measures are Unnecessary. . .	30
F.	The Commission Need Not Regulate Interference Into BPL . . . . .	33
G.	The Commission Should Adopt Its Proposed Technical Rules. . . . .	34
1.	Emissions limits . . . . .	34
2.	Measurement Procedures . . . . .	35
3.	Equipment authorization procedures . . . . .	37
H.	The Commission Should Not Regulate the Ownership of BPL Systems. . . . .	38
I.	Issues of Regulatory Jurisdiction and Service Regulation Are Outside the Scope of this Proceeding. . . . .	39
	CONCLUSION . . . . .	41

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Pursuant to Section 1.415 of the Commission's Rules, Current Technologies, LLC, a leading provider of broadband over power line (BPL) technology, files these Reply Comments in the above-captioned proceeding.<sup>1</sup>

**A. Summary**

Current Technologies, in collaboration with its sister company, Current Communications, has deployed and is expanding a successful, full-scale commercial BPL system in the greater Cincinnati, Ohio marketplace. Current Technologies has designed its BPL equipment specifically to prevent interference to incumbent spectrum users. This deployment constitutes empirical evidence that properly designed BPL systems do not and will not cause interference to licensed users.

The first-round comments in this proceeding confirm two principles. First, BPL is important to the public interest, both in offering a "third wire" for broadband and in adding intelligence to the U.S. electric grid. Second, sound BPL system design under appropriate,

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<sup>1</sup> *New Requirements and Measurement Guidelines for Access Broadband over Power Line Systems*, 19 FCC Rcd 3335 (2004) (Notice).

technology-neutral rules can provide a win/win compatibility between the interests of incumbent spectrum users, on the one hand, and the operations and advantages of BPL, on the other. Properly implemented BPL systems, such as Current Technologies', present no significant potential for interference.

The public interest in BPL arises in large part from its promise to provide broadband service to homes and small businesses in geographic areas not presently reached by other providers, and to bring new competition, and hence lower prices and better service, to areas otherwise limited to DSL and/or cable modem service. President Bush recently noted the importance of BPL in broadband delivery.<sup>2</sup> An additional benefit is BPL's facilitation of enhanced power distribution services, which will lower the cost and increase the reliability of electric service.

Concern over BPL rests almost entirely on suggestions that it will cause interference to licensed radio services. These issues are best addressed through an examination of how well-designed, Part 15 compliant BPL systems actually operate.

At the outset, no party questions the application of the Part 15 emissions limits to BPL. But some comments do suggest that long lengths of power line will radiate radio-frequency energy; or that interference from multiple BPL devices will aggregate; or that irregularities in the

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<sup>2</sup> "Regulatory policy has got to be wise and smart as we encourage the spread of [broadband] technology. There needs to be technical standards to make possible new broadband technologies, such as the use of high-speed communication directly over power lines. Power lines were for electricity; power lines can be used for broadband technology." Remarks of President George W. Bush at American Association of Community Colleges Annual Convention, Minneapolis, Minnesota (April 26, 2004). <http://www.whitehouse.gov/news/releases/2004/04/20040426-6.html>

power distribution system will produce out-of-band frequencies; or that "skywave" propagation will cause BPL interference at locations distant from the source.

Each of these concerns is unwarranted, having no application to real-world BPL. Careful measurements of Current Technologies' deployments find detectable BPL emissions only immediately adjacent to the device that couples to the medium voltage line, not from or along stretches of the line itself. Each overhead Current Technologies BPL device is silent for all but a small fraction of the time, so the density of devices operating at any instant is very sparse -- far below levels that could cause cumulative interference -- and underground deployments are extremely well shielded. The physical defects in power distribution systems needed to produce out-of-band signals do not occur in sufficient magnitude to be troublesome, and in any event tend to be self-correcting. Skywave propagation, caused by reflection from the earth's ionosphere, yields signals far too weak to interfere.

The debate on these topics underscores the need for the Commission to rest its rules on actual measurements of compliant BPL systems. No other basis is sufficiently reliable to yield accurate conclusions.

NTIA filed comments that report on both computer simulations and field measurements of BPL systems. But the two types of studies did not yield consistent results, and the discrepancies cannot be reconciled. A major weakness in the simulations is a set of starting assumptions that do not reflect actual practice or specific system design or implementation. In consequence, any attempt to apply the simulation results to real-world BPL systems becomes inaccurate and unreliable. For example, the simulations use a pure tone on the power line where real BPL uses a broadband signal having a far lower propensity to cause interference. NTIA's

simulated means of coupling to the power line contradicts actual practice by BPL vendors. The choices of modeled frequencies and line lengths set up standing waves on the power line. And the duty cycle (percentage of "on" time) for each modeled device is greatly overstated. Each of these factors causes an overestimate of BPL interference potential. Furthermore, in evaluating the results, NTIA assumed a 0.1 dB increase in noise level would cause harmful interference, when in practice that level is far too low to have any effect.

NTIA's field measurements raise other inconsistencies. The study combined data from three different BPL technologies that use different power levels, frequency plans, coupling methods, and system architectures. By commingling the results, without taking into account the elements designed into Current Technologies' equipment specifically to prevent interference, NTIA's study overstates the interference potential of Current Technologies' system (and possibly others). Each approach must be fairly assessed on its own terms.

We support the Commission's proposed methods for mitigating interference (assuming adequate lead time to implement them), although we expect they will be needed rarely, if at all. It is unrealistic for spectrum users to expect mitigation in real time, but BPL providers should be required to respond in a reasonable time, under the circumstances. Placing the BPL deployment database with a trusted third party and charging that same party with investigating interference complaints and coordinating mitigation measures will help to speed the resolution of individual cases. Indeed, NTIA concludes the introduction of BPL will *reduce* overall interference by giving utilities both the incentive and the means to reduce non-BPL-related power line noise.

NTIA proposes numerous measures intended to prevent BPL interference. But each of them unduly and unnecessarily burdens BPL by impairing one or both of its core attributes for

economic success: transmission range and data capacity. NTIA's measures also threaten to increase the cost of BPL devices so much as to potentially price the service out of the market. And there is no evidence these measures are needed. The proposals rest on the NTIA studies mentioned above, which overestimate the interference potential from BPL. Properly designed BPL devices that comply with Part 15 limits will require no more in the way of protective measures than any other digital devices.

The interference measures put forward by NTIA are also superfluous in light of the technical rules proposed in the Notice, which will better achieve both the Commission's and NTIA's objectives for spectrum compatibility. For example, NTIA would replace the proposed measurements at specified fractional wavelengths along the line with a comprehensive search for the peak field strength. We concur with NTIA's goal, but we think the Commission must specify a procedure to look for the peak, or some manufacturers may be tempted to cut corners. Second, rather than measure emissions at heights of 1-4 meters, as the Commission proposes, NTIA suggests measurement at a uniform one-meter height subject to a 5 dB "correction." We submit that the Commission's proposed measurement method will better reflect the performance of actual BPL systems. Third, NTIA not only wants BPL devices to be certified, but certified to the BPL operator, rather than the manufacturer. The Commission has rarely called for certification of fixed devices that are professionally installed, as all Access BPL equipment will be. Imposing certification procedures would unnecessarily burden a nascent industry and discourage innovation by making technical improvements slower and more expensive. And we do not see how a provider can fairly be asked to take responsibility for the compliance of equipment over whose manufacture it has no control.



Finally, the Administrative Procedure Act bars the Commission from taking on several parties' requests to regulate services provided via BPL. And we think a Further Notice on those issues would be a mistake. A shift in subject matter from Title III technical limits and measurement procedures to Title II regulatory and jurisdictional issues calls for a new docket.

On balance, we are confident BPL can deliver important benefits with no significant risk of interference to other services. We urge the Commission to adopt its proposed rules, with the minor modifications set out in Current Technologies' first-round comments, at the earliest possible date.<sup>3</sup>

**B. BPL is in the Public Interest.**

The large majority of filings that comment on the issue agree BPL is in the public interest. Even parties otherwise concerned about BPL readily concede its benefits. The Central Station Alarm Association, for example, recognizes that the reach of power lines into virtually every community in the country gives BPL the potential to bring Internet and high-speed broadband access to persons and locations that currently have limited choices.<sup>4</sup> The American Petroleum Institute agrees with the Commission that BPL may offer substantial public and private benefits.<sup>5</sup> Public safety representatives see merit in BPL as a new technology that can

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<sup>3</sup> *Note on citations.* Unless otherwise marked, citations refer to parties' first-round Comments, generally filed on or before May 3, 2004. Citations to early-filed Reply Comments so indicate. Citations to "NTIA" refer to Comments of the National Telecommunications and Information Administration (filed June 4, 2003).

<sup>4</sup> Central Station Alarm Ass'n at 1.

<sup>5</sup> American Petroleum Institute at 3.

potentially provide broadband service to underserved rural areas.<sup>6</sup> NTIA notes that BPL will "contribute significantly toward fulfillment of the President's vision for universal affordable broadband Internet access."<sup>7</sup> Even some amateur radio operators agree that BPL may play a role in competition, and perhaps provide a mechanism to bring broadband to rural and underserved areas.<sup>8</sup>

Some parties comment specifically on the promise of BPL for broadband deployment to rural areas and other locations overlooked by existing broadband technologies.<sup>9</sup> Others note the benefits of more competition. AT&T, for example, sees cable and DSL providers converging on a 50/50 duopoly that will benefit both industries, and hence discourage further competition between them, in the absence of an alternative broadband path such as BPL.<sup>10</sup>

Utilities point out the advantages of enhanced power distribution services via BPL, including such features as automated meter reading, automated power outage and restoration detection, power quality monitoring, load management, and demand side management, especially the capability of detecting faulty components *before* they fail.<sup>11</sup> NTIA notes that BPL provides

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<sup>6</sup> Association of Public-Safety Communications Officials Internat'l, Inc. and National Public Safety Telecommunications Council at 2.

<sup>7</sup> NTIA at iv.

<sup>8</sup> *E.g.*, Ronald K. Wray at 3.

<sup>9</sup> *E.g.*, National Rural Telecommunications Cooperative and National Rural Electric Cooperative Ass'n at 4-5; PowerWAN, Inc. (pages unnumbered).

<sup>10</sup> AT&T at 2-3.

<sup>11</sup> Cinergy Corp. at 2; Southern Telecom, Inc. and Southern Company Services, Inc. at 3-6; Hawaiian Electric Co. at 2; Consolidated Edison Co. of New York at 3.

not only the means, but also an economic incentive, for provision of more reliable electric service.<sup>12</sup> The resulting improved reliability benefits everyone, says NTIA -- consumers and businesses alike -- regardless of whether they subscribe to BPL.<sup>13</sup>

A few parties argue that other broadband technologies, such as wireless, fiber, and satellite, can reach underserved areas and/or provide competition as well as BPL.<sup>14</sup> Yet 80% of American homes still do not have broadband access.<sup>15</sup> Of those that do, fully 97% rely on either cable or wireline (mostly DSL).<sup>16</sup> The alternatives have simply failed to deliver broadband service at competitive costs. To be sure, some technologies may show better penetration in the future. The Commission is working hard to find new spectrum for wireless solutions,<sup>17</sup> and has reallocated spectrum to facilitate satellite delivery.<sup>18</sup> But neither of these options -- or fiber,

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<sup>12</sup> NTIA at 6.

<sup>13</sup> NTIA at 5.

<sup>14</sup> ARRL at 2 n.1 (wireless and fiber); CQ Communications at para. 9 (802.16/802.11 wireless networks); Disaster Emergency Response Ass'n at para. 4 (802.11x, direct satellite data service, ISDN, DSL, cable modems).

<sup>15</sup> *Cable/Satellite & Telecom Cross Industry Insights*, Morgan Stanley Equity Research (April 12, 2004).

<sup>16</sup> *High-Speed Services for Internet Access: Status as of December 31, 2003*, Industry Analysis and Technology Division, Wireline Competition Bureau at chart 2 (June 2004).

<sup>17</sup> *FCC Promotes the Deployment of Wireless Broadband Services*, WT Docket No. 03-66, News Release (released June 10, 2004); *Unlicensed Operation in the TV Broadcast Bands*, ET Docket No. 04-186, Notice of Proposed Rulemaking FCC 04-113 (released May 25, 2004); *Unlicensed Operation in the Band 3650-3700 MHz*, 19 FCC Rcd 7545 (2004); *Establishment of an Interference Temperature Metric*, 18 FCC Rcd 25309 (2003); *Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, 18 FCC Rcd 24484 (2003).

<sup>18</sup> *Redesignation of the 17.7-19.7 GHz Frequency Band*, 17 FCC Rcd 24248 (2002) (redesignating 18.3-18.58 GHz); *Redesignation of the 17.7-19.7 GHz Frequency Band*, 15 FCC

which is even more expensive -- is likely to bring broadband soon to the tens of millions of homes that need it. Other parties propose broadband delivery using vacant TV channels or microwave frequencies.<sup>19</sup> Both options are the subject of ongoing rulemakings,<sup>20</sup> and each may have a niche, if their technical problems can be worked out, but neither will be cost-competitive with cable and DSL over large areas or large populations. In short, BPL cannot resolve the broadband "digital divide" alone, but it will be a necessary and significant part of the solution.

Some critics suggest BPL may not be able to compete effectively in the marketplace.<sup>21</sup> Today broadband coverage in the United States is far from ubiquitous, with a significant portion of the population having no available broadband access at all. BPL developers like Current Technologies have designed their systems to achieve both technical and economic viability in order to compete successfully with existing delivery technologies, where those exist. But BPL's success in the market need not be the Commission's concern. Congress has decided, "It is the policy of the United States to encourage the provision of new technologies and services to the public."<sup>22</sup> All the Commission need do is give new technologies and services a chance to compete so the marketplace can choose among them. No one can seriously dispute that

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Rcd 13430 (2000).

<sup>19</sup> North American Shortwave Ass'n. at 7-8; Ronald K. Wray at 5.

<sup>20</sup> *Unlicensed Operation in the TV Broadcast Bands*, ET Docket No. 04-186, Notice of Proposed Rulemaking FCC 04-113 (released May 25, 2004); *FCC Promotes the Deployment of Wireless Broadband Services*, WT Docket No. 03-66, News Release (released June 10, 2004).

<sup>21</sup> Glenn W. Pelikan at 2; CQ Communications at paras. 6, 7.

<sup>22</sup> 47 U.S.C. Sec. 157(a).

competition reduces prices and increases value and alternatives. In the end, an offering of better service at lower prices can only help consumers.

**C. Properly Designed BPL Is Fully Compatible with Licenced Spectrum Use.**

Current Technologies has consistently shown that properly designed and maintained BPL systems can harmlessly coexist with licensed radio services. More than two years of pre-commercial operations, and now expanding commercial operations, confirm that Current Technologies' BPL equipment does not interfere with existing users. Nearly all of the opposition to BPL -- and all of the NTIA-recommended rule changes -- rest on the incorrect assumption that BPL will interfere with licensed radio services. We reiterate below why this premise is untrue.

Parties to the proceeding variously express concern about BPL interference to the following services (in alphabetical order): aeronautical HF communications,<sup>23</sup> alarm systems at 450-470 MHz,<sup>24</sup> AM broadcast receivers,<sup>25</sup> amateur bands,<sup>26</sup> amateur bands above 903 MHz,<sup>27</sup> amateur radio astronomy,<sup>28</sup> amateur radio satellite operations,<sup>29</sup> broadcast auxiliary service at 26

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<sup>23</sup> Aeronautical Radio, Inc.; The Boeing Company at 2-6.

<sup>24</sup> Central Station Alarm Ass'n at 4-5.

<sup>25</sup> Consumer Electronics Ass'n; Society of Broadcast Engineers, Reply Comments at 5-6 (Emergency Alert System broadcasts); Ronald K. Wray at 14-15 (Emergency Alert System broadcasts).

<sup>26</sup> ARRL; CQ Communications; Ronald K. Wray at 1-2, 6-10; Ray Soifer; Carl R. Stevenson; about 1200 others in ET Docket No. 04-37.

<sup>27</sup> Roadrunners Microwave Group.

<sup>28</sup> Society of Amateur Radio Astronomers (17-30 MHz); Pisgah Astronomical Research Institute at 1.

<sup>29</sup> Radio Amateur Satellite Corp.

MHz,<sup>30</sup> federal Government communications,<sup>31</sup> land mobile communications below 150 MHz,<sup>32</sup> maritime communications,<sup>33</sup> PCS and MDS communications,<sup>34</sup> public safety,<sup>35</sup> paging and other telecommunications service provided by small businesses,<sup>36</sup> radio astronomy,<sup>37</sup> radio control

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<sup>30</sup> Society of Broadcast Engineers, Reply Comments at 5.

<sup>31</sup> NTIA.

<sup>32</sup> American Petroleum Institute; Society of Broadcast Engineers, Reply Comments at 7.

<sup>33</sup> ShipComm LLC (seeks ban on BPL around Maritime Public Coast stations, airports, military bases, and hospitals); Society of Broadcast Engineers, Reply Comments at 7.

<sup>34</sup> Sprint Corp.

<sup>35</sup> APCO Region 21 [Michigan] Frequency Advisory Committee (39 MHz, 155 MHz, 460 MHz, 700 MHz, and 800 MHz); Missouri State Highway Patrol (42 MHz); Association of Public-Safety Communications Officials Internat'l, Inc. and National Public Safety Telecommunications Council (2-7 MHz, 30-50 MHz, and 72-76 MHz); International Municipal Signal Ass'n (call boxes at 72 MHz, 75 MHz).

<sup>36</sup> Small Business in Telecommunications.

<sup>37</sup> National Academy of Sciences' Committee on Radio Frequencies at 4-5, 7 (seeks to maintain present Part 15 protections, at 4-5; but notch down to 100 uV/m at 3m at 13.36-13.41 MHz, 25.55-25.67 MHz, 37.5-38.25 MHz, 73-74.6 MHz); Society of Broadcast Engineers, Reply Comments at 7.

model aircraft,<sup>38</sup> short-wave reception at 5.9-26.1 MHz,<sup>39</sup> telephone drop wires,<sup>40</sup> telephone voice, DSL, and VDSL services,<sup>41</sup> trucking communications,<sup>42</sup> and TV bands.<sup>43</sup>

*None of the parties cited here challenges the suitability of the numerical Part 15 limits for BPL.*<sup>44</sup> Rather, the filings that offer any support for interference concerns rely on one or more of the following claims: (a) power lines are a "distributive source"; (b) interference from multiple BPL devices will aggregate; (c) elements of the power distribution system will produce harmonics and intermodulation products; or (d) skywave propagation will cause BPL interference at locations distant from the source.<sup>45</sup> We show below that these assertions are not accurate.

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<sup>38</sup> Academy of Model Aeronautics (27 MHz, 50-54 MHz, 72 MHz, and 75 MHz).

<sup>39</sup> North American Shortwave Ass'n; (Mr.) Tracy K. Wood.

<sup>40</sup> BellSouth at 6.

<sup>41</sup> Verizon.

<sup>42</sup> Global2Way Acquisition, LLC at 2 (one-watt transmissions from trucks will be swamped by adjacent power lines).

<sup>43</sup> Association for Maximum Service Television, Inc.; Society of Broadcast Engineers, Reply Comments at 5; Consumer Electronics Ass'n; Disaster Emergency Response Ass'n at para. 3 (interference to off-the-air TV primarily affects poor people).

<sup>44</sup> Notice at para. 38. NTIA (at 7-8) would notch below the Part 15 limits at certain frequencies.

<sup>45</sup> Also, BellSouth (at 4-5) and Society of Broadcast Engineers (Reply Comments at 3) cite potential (not actual) interference from cable TV leakage as foreshadowing BPL interference. The analogy fails for several reasons. First, the technologies are utterly different. Second, cable leakage reflects a defect in "containment" of a high-powered conducted signal. Third, the power spectral densities that are *permitted* to leak from a cable system are tens of dB higher than the Part 15 limits. 47 C.F.R. Sec. 76.610. Even widespread interference from cable TV leakage -- which not does not occur -- would not predict a risk from BPL.

NTIA cites simulations and measurements that, it says, predict interference from BPL, and we respond to those as well.

***1. NTIA finds that application of BPL standards will reduce power line noise.***

NTIA explains that the implementation of BPL, far from increasing present levels of interference, will reduce the power line noise that presently plagues radio communications. Power line noise impedes the transmission of BPL signals, which must operate at the very low levels limited by Part 15. This gives a utility offering BPL service, or relying on it for enhanced utility management services, every incentive to reduce power line noise.<sup>46</sup> That directly benefits radio users in the vicinity. Moreover, enhanced power distribution services via BPL will help to pinpoint the source of noise and facilitate its prompt repair.<sup>47</sup>

***2. Power lines do not radiate Current Technologies' BPL signals.***

Several comments assert the Part 15 limits provide adequate protection from point-source emitters, but not from BPL.<sup>48</sup> The difference, they say, is that BPL signals radiate from the entire length of the power line, effectively turning the power distribution system into a giant antenna.

*No party presents any evidence for radiation from the power line.* ARRL's "Exhibit C" claims to establish that power lines radiate. Instead, though, it begins by assuming that as fact,

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<sup>46</sup> NTIA at 5.

<sup>47</sup> NTIA at 5.

<sup>48</sup> ARRL at 2-3, 5, 9-10; Aeronautical Radio, Inc. at 7-9; IEEE-USA at para. 10; The Boeing Company at 10; Ronald K. Wray at 1-8, 11-13.; Radio Amateur Satellite Corp. at 4; Pisgah Astronomical Research Institute at 2; Southeastern VHS Society at 2; Academy of Model Aeronautics. at 4; Carl R. Stevenson at para. 7.



and goes on to discuss the supposed consequences, without attempting to offer proof of any kind. Aeronautical Radio, Inc. cites its own simulation study without providing either details or actual data. Carl R. Stevenson does provide data, but they do not establish the emissions are from the power line, as opposed to the BPL device.<sup>49</sup>

The notion that power lines will radiate BPL signals has taken on the status of an urban myth -- an assertion people "know" is true because others say it is true. Hundreds of pleadings in this docket assert power line radiation of BPL signals as an established fact, but they cite only to one another, not to authoritative data. The only field measurements on point are the excerpts that Current Technologies presented in its first-round comments -- data taken directly under the power line that plainly refute claims of radiation from the line.<sup>50</sup> Those measurements establish that BPL emissions decay as the inverse square of distance, which is the identifying characteristic of a point source emitter.<sup>51</sup> There can be no clearer proof that the power line need not radiate in a carefully designed BPL system.<sup>52</sup>

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<sup>49</sup> Carl R. Stevenson at Attachment 1.

<sup>50</sup> Current Technologies, LLC at 14-15.

<sup>51</sup> *Accord*, PowerWAN, Inc. (pages unnumbered).

<sup>52</sup> The Society of Broadcast Engineers (Reply Comments at 2) claims the Current Technologies data shows BPL radiation "only" 10 dB below that predicted for a line source. Hence, it says, those data support claims that the line radiates. We invite SBE to take a closer look at the plot. *See* Current Technologies at 15, Figure 1. The curve of signal strength vs. distance closely follows the  $1/R^2$  trajectory expected for a point source emitter, not  $1/R$  as from a line source. The curve ends at about 10 dB down (40 meters from the source) because the signal at greater distances is simply too weak to measure. SBE (at 2) states it might have been convinced by data showing emissions 40-50 dB below those predicted for a line source. But BPL devices are sufficiently quiet that the values SBE seeks would be tens of dB below the noise floor. Current Technologies has made its case for point-source emissions.

3. *Current Technologies' emissions do not aggregate harmfully.*

Some parties suggest that, even if one BPL device were acceptable, the emissions from multiple devices would aggregate to cause harmful interference.<sup>53</sup>

Current Technologies has shown that emissions from its devices do not aggregate harmfully. As we explained previously,<sup>54</sup> only two of these devices in conjunction with a given distribution transformer operate simultaneously -- one medium-voltage device and one low-voltage device. Even these operate at different frequencies, in Current Technologies' implementation, so they cannot affect the same narrowband receiver. The typical spacing of transformers, several tens to hundreds of meters apart, makes the geographic density of devices operating at any instant extremely sparse. Moreover, because Current Technologies' BPL devices are point-source radiators, their emissions drop off rapidly with distance. While any of these attributes would significantly mitigate the potential for "cumulative" emissions, the combined effect of all of them, taken together, eliminates any possibility of significant cumulative emissions. Aggregation from BPL devices will be far less than from more commonplace emitters such as laptops and vehicle engine computers.

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<sup>53</sup> American Petroleum Institute at 4; The Boeing Company at 10; Ronald K. Wray at 8-9; Pisgah Astronomical Research Institute at 3. One party even alleges (without support) a health risk from cumulative RF exposure. CQ Communications at para. 21. This is nonsense. Current Technologies' equipment operates at 30-50 MHz. Even at worst-case Class A levels (90  $\mu\text{V/m}$  over 100 kHz at 10m) across 20 MHz of bandwidth, the effective isotropic radiated power at the distribution line is 5.39  $\mu\text{W}$ , or -22.7 dBm. At 5 cm distance from the line, the power density equals 0.000017  $\text{mW/cm}^2$ , or 47 dB below the occupational limit of 1.0  $\text{mW/cm}^2$ . Even at that close distance -- accessible only to a trained lineman -- the level is 40 dB below the general population limit of 0.2  $\text{mW/cm}^2$ . At that distance there can be no aggregation, and at greater distances the power density drops off to insignificance.

<sup>54</sup> See Current Technologies, LLC at 16-17.

NTIA's analysis confirms this conclusion: "Considering realistically dispersed deployments of BPL systems, it would take hundreds of thousands of Access BPL devices operating under existing rules to cause a 1 dB increase in median noise."<sup>55</sup> Considering that NTIA overestimated the feasible density of operating BPL devices,<sup>56</sup> among other factors, even that estimate is unduly pessimistic.

**4. *Power lines cannot generate noncompliant harmonics and intermodulation products from BPL signals.***

Some parties fear that impedance discontinuities in the power distribution system will cause BPL signals to produce harmonics and intermodulation products.<sup>57</sup> This is not the case. Harmonics and intermodulation products can arise only from rectification -- *i.e.*, from nonlinearities in the transmission line that result in lower resistance to current flowing in one direction than in the other. Although it is theoretically possible for corrosion or contact between different materials to cause these nonlinearities, the constant high levels of 60 Hz current flowing through the system tend to break down any corrosion. Moreover, because the physical processes are extremely inefficient, any rectification that does occur is extremely slight. This puts the total power in the rectified signal far below the original signal, which meets the Part 15 limits. Current Technologies has conducted a thorough analysis across its deployments, specifically seeking any indication of harmonics and intermodulation products, but has not detected even the

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<sup>55</sup> Comments of the National Telecommunications and Information Administration, Technical Appendix at 4-4 (filed June 4, 2003) ("NTIA Technical Appendix").

<sup>56</sup> See Part C.7, below.

<sup>57</sup> CQ Communications at paras. 17-18; Ronald K. Wray at 22-23; Radio Amateur Satellite Corp. at 2-3; Ray Soifer at 4-5.

slightest evidence for their existence. We understand that NTIA was similarly unable to find any evidence of these effects in lines served by Part 15 compliant equipment.

**5. *Impedance discontinuities cannot add significantly to BPL emissions.***

Far from causing harmonics and intermodulation products, impedance discontinuities in the transmission line do not even radiate appreciably at BPL frequencies. Rather, Current Technologies' experiments show they reflect a small fraction of the conducted energy back toward the source, much as a glass window reflects a fraction of the light impinging on it. But these emissions are necessarily smaller -- in practice, very much smaller -- than the point source emissions associated with the original signal. In consequence, discontinuities have little or no effect on emissions.

Reflections back to the BPL device are included in the measurement of emissions. But even if a particular installation has a discontinuity greater than those in the installations measured for compliance, the fraction of reflected energy is always less than 100% -- usually far less -- and that puts an absolute upper bound on the emissions due to the reflection. Thus, even an unmeasured installation with a high level of discontinuity cannot have emissions appreciably greater than the installations measured for compliance.

**6. *Skywave propagation is not a significant factor in interference.***

Some parties fear that skywave propagation -- reflections from ionized layers in the earth's atmosphere -- will cause interference at great distances from BPL devices.<sup>58</sup> Skywave effects increase the range of high-power short-wave stations in some of the frequency ranges

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<sup>58</sup> CQ Communications at paras. 14-16; Aeronautical Radio, Inc.

contemplated for BPL. But it does not follow that BPL signals will interfere at comparable distances. Skywave effects disperse the original signal over tens of thousands of square miles, and the great distances involved attenuate the signal by many orders of magnitude. Skywave reflections may still deliver a useful signal if the originating short-wave station has enough power, typically hundreds or thousands of watts. But the skywave dispersion of a BPL emission, which is limited to nanowatts at the source, cannot realistically cause interference many miles away. A BPL signal drops into the noise just a few tens of meters (at most) from the source device. To think the same signal can cause interference hundreds of miles away is unrealistic, to say the least. NTIA's extensive modeling yields the same conclusion.<sup>59</sup>

**7. *NTIA's interference findings do not apply to Current Technologies' implementation.***

NTIA rests its recommendations on its assessment of BPL's interference potential.<sup>60</sup> Current Technologies respectfully questions some of the elements that underlie NTIA's findings in that regard, in some cases as to BPL generally and in others as they apply specifically to our own implementation.

At the outset, we note that NTIA undertook both a theoretical simulation, based on a specific computer model of BPL operation, and field measurements of BPL systems installed by three different manufacturers. It concerns us that data from field measurements and the modeling

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<sup>59</sup> NTIA Technical Appendix at 4-4.

<sup>60</sup> See generally *Potential Interference from Broadband over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7 - 80 MHz*, Phase 1 Study, NTIA Report 04-413 (U.S. Dept. of Commerce April 2004) (Phase 1 Study); NTIA Technical Appendix. In Part E, below, we show why NTIA's proposed measures to reduce interference are unneeded as to BPL in general and as to Current Technologies' implementation in particular.

results do not agree or correlate. NTIA has not accounted for the discrepancies. The disparate outcomes suggest that either the model or the field measurements -- or possibly both -- are not yielding a fully accurate picture of BPL. That in turn casts doubt on whether NTIA's recommendations are well supported.

Moreover, in several respects the modeling assumptions depart significantly from actual practice:

- ***Nature of BPL signal.*** NTIA's model represents BPL signals as a single-frequency tone. Actual BPL systems use a broadband, noise-like signal which has much lower interference potential. In part, this is because broadband noise puts far less energy into a narrow-band receiver than a single-frequency tone of the same power. Also, noise (by definition) has no correlation between pulses, so the sharp nulls and peaks found by NTIA would not occur in real systems.
- ***Power line coupling.*** NTIA's simulations place the BPL signal on the power line by creating a differential voltage signal in the middle of the line. In practice that is all but impossible to do without cutting the line. The couplers used by Current Technologies (and other BPL vendors) display very different characteristics and result in different propagation along the line.
- ***Phase mismatch.*** NTIA's model uses frequencies and line lengths that create a phase mismatch equal to 1/3 of a wavelength at each end of the line. This sets up standing waves, very much like the sound waves in an organ pipe. The results are not representative of emissions from actual BPL devices using noise-like signals, which cannot cause standing waves.
- ***Duty cycles.*** NTIA assumes that one-half of BPL devices are operating at any time. Current Technologies uses a time division duplex (TDD) sharing protocol in which each device operates 10% of the time or less, greatly cutting down the interference potential.
- ***Interference criterion.*** NTIA assumes a 0.1 dB increase in noise level would cause increased interference. This value represents barely a 2% increase, which cannot have any practical effect on any receiver.

We also have questions about NTIA's field measurement results. The study commingles data from three different BPL systems that use different architectures, which can yield misleading results. For example, Current Technologies' system uses power levels that are lower by tens of dB than those used by the other measured systems, so the combined data greatly exaggerate Current Technologies' interference potential. Bearing out that contention are NTIA field measurements showing that Current Technologies' emissions are in the noise floor for co-frequency federal systems. Moreover, Current Technologies places frequencies below 30 MHz, where attenuation is less and authorized emissions levels are higher, only on the shorter, irregularly configured low-voltage wires. The other measured systems use those frequencies on the medium-voltage lines, which run for much longer distances in regular configurations, and therefore may create a more significant source of potential interference. No doubt there can be carefully designed systems very different from Current Technologies' having a similarly low threat of interference to licensed services. But NAIA's mixture of results does not provide conclusions attributable to any system.

In short, both the NAIA simulation studies and field measurements overstate the risk of interference, in some respects as to Current Technologies' system, and in some respects as to BPL generally. Properly designed, Part 15 compliant BPL will be no more interfering than the hundreds of millions of digital devices already in use.

**D. The Commission's Mitigation Proposals Can Fully Protect Other Users Without Unduly Burdening BPL.**

Current Technologies supports some of the Commission's proposals for interference mitigation measures: both "adaptive interference mitigation techniques," such as adjusting

frequency usage on a dynamic or remote controlled basis in response to proven interference,<sup>61</sup> and a shut-down feature to deactivate units that do not respond to lesser measures.<sup>62</sup> We endorse these precautions (subject to the grandfathering period proposed in our original comments<sup>63</sup>) because we are confident the Part 15 limits will provide adequate interference protection, so that mitigation measures be needed rarely, if at all.

Some parties, however, are skeptical about mitigation. They contend that BPL providers must avoid interference *ab initio*, because *post hoc* mitigation comes too late.<sup>64</sup> We agree that preventing interference in the first place is by far the most effective mitigation, and have engineered our system accordingly. The Part 15 limits for unintentional radiators -- those applicable to BPL -- were carefully chosen to avoid interference even to nearby sensitive receivers.<sup>65</sup> Indeed, the Part 15 limits are tens of dB lower than the *out-of-band* limits for licensed users. Although never intended to reduce the possibility of interference to absolute

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<sup>61</sup> Notice at para. 40.

<sup>62</sup> Notice at para. 42.

<sup>63</sup> See Current Technologies, LLC at 19.

<sup>64</sup> ARRL at 7-12; Association of Public-Safety Communications Officials Internat'l, Inc. and National Public Safety Telecommunications Council (pages unnumbered).

<sup>65</sup> In adopting the present Part 15 rules, the Commission responded to specific concerns about interference into broadcast TV, land mobile, public safety, and amateur receivers. *Amendment of Part 15 to Redefine and Clarify the Rules Governing Restricted Radiation Devices and Low Power Communication Devices*, 79 F.C.C.2d 28 at paras. 11-14 (1979), *recon. on other grounds*, 79 F.C.C.2d 67 (1980).



zero,<sup>66</sup> the limits represent a reasonable balance between the public interest in the operation of digital devices, including BPL, and in licensed users being free of harmful interference.

Like other BPL providers, we have every incentive to avoid the service disruptions *post hoc* measures would cause, and so Current Technologies designed its system to avoid causing interference from the outset. NAIA likewise predicts that frequent shut-downs would soon cut into BPL's market appeal. That, says NAIA, gives BPL operators "strong incentives to prevent and eliminate interference."<sup>67</sup>

### ***1. Mitigation response times***

Some parties are concerned about the length of time it will take BPL providers to resolve interference complaints. They variously seek assurance that response will be in minutes or seconds,<sup>68</sup> "quickly and expeditiously,"<sup>69</sup> within 10 minutes,<sup>70</sup> or "now."<sup>71</sup> Some commenters want BPL providers to implement mitigation measures immediately on the say-so of a complainant, even without evidence that BPL is causing the interference.<sup>72</sup> NTIA seeks a

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<sup>66</sup> See 47 C.F.R. Sec. 15.15(c) ("Parties responsible for equipment compliance should note that the limits specified in this part will not prevent harmful interference under all circumstances.")

<sup>67</sup> NTIA at 8.

<sup>68</sup> ARRL at 23 n.16.

<sup>69</sup> Small Business in Telecommunications at 10.

<sup>70</sup> North American Shortwave Ass'n at 5.

<sup>71</sup> Carl R. Stevenson at para. 10 n. 6.

<sup>72</sup> Academy of Model Aeronautics at 6.

requirement for testing on receipt of an interference complaint (by shifting frequencies or turning off the system) either during the complaining phone call or shortly afterward.<sup>73</sup>

For the reasons listed in Part C, above, we expect well-founded complaints of interference from BPL to be extremely rare. But if they do arise, it is unrealistic to expect resolution in a matter of minutes. We think BPL providers should be required to resolve an interference complaint within a reasonable time after receiving all pertinent data.<sup>74</sup> But what constitutes a "reasonable time" may vary depending on the complexity of the fact pattern. Claims of interference on a heavily used frequency in a congested urban core may take longer to investigate and resolve than claims on an otherwise quiet frequency away from population centers. Users who deploy sophisticated and sensitive mobile equipment for the express purpose of seeking out interference, solely to create grounds for a complaint, should not be entitled to any response.<sup>75</sup>

Our first-round comments propose that complaints of suspected BPL interference be directed in the first instance to a designated, trusted third party having access to a complete database of BPL installations. That entity would investigate the complaint, notify potentially responsible BPL providers, and if necessary coordinate mitigation measures. We made the proposal in part to avoid the need for public disclosure of proprietary information on BPL systems and to preserve the security of information on critical electric distribution

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<sup>73</sup> NTIA at 13.

<sup>74</sup> Those data might typically include the dates and times of interference, receiver location, frequency, receiver modulation, antenna type, gain, azimuth, and a description of the interference.

<sup>75</sup> *See* Progress Energy, Inc. at 8.

infrastructure.<sup>76</sup> But the proposal should also help to assure licensed users that interference complaints will receive prompt attention. Even if the local BPL provider lacked incentive to investigate interference, the third-party entity would not. Because resolving interference complaints is its major reason for existence, it will have every reason to move quickly.

Still, even a well-intentioned interference complaint against BPL can be mistaken. NTIA acknowledges that suspected interference may be due not to BPL but to problems in the complainant's receiver, antenna, or interconnecting transmission line.<sup>77</sup> Requiring a BPL provider to effect system changes to confirm BPL as the source of interference before even a preliminary determination that the BPL is potentially the cause, as NTIA suggests elsewhere,<sup>78</sup> would open an easy way for malicious complaints to shut down a system.

Some users are pessimistic about the mitigation process because, they say, utilities have been slow in the past to address complaints of non-BPL-related interference.<sup>79</sup> For at least two reasons, however, previous experience with utilities is irrelevant to BPL mitigation. First, utilities have no database of potential interference sources to facilitate the identification and mitigation of harmful interference, as the Commission proposes for BPL. Second, spectrum users suspecting interference will deal with BPL providers, rather than the utilities in their traditional role as electricity providers, in which they have minimal interference-related

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<sup>76</sup> Current Technologies, LLC at 18-23. *See also* Part D.4, below.

<sup>77</sup> NTIA at 2 n.6.

<sup>78</sup> NTIA at 13.

<sup>79</sup> ARRL at 13-14; Pisgah Astronomical Research Institute at 3; Southeastern VHS Society at 3.

obligations under Commission rules. But all BPL providers -- even those that are utility affiliates -- have an enforceable legal responsibility to protect licensed users, and in that capacity are accountable to the Commission for their actions and omissions.

## **2. *Mitigation methods***

Some parties stress that providers should have flexibility in designing their own mitigation techniques.<sup>80</sup> We agree this is necessary. Assuming the Commission does not intend to establish a standard design for BPL equipment -- a move that would violate long-held policies of technology neutrality -- it is not well positioned to prescribe specific technical measures for mitigation. Some parties want the Commission deeply involved in the engineering process.<sup>81</sup> But we urge that all decisions on implementing mitigation be left with the equipment designers. The Commission should insist that providers be able to locate and remedy sources of interference, but it should not prescribe how.

Some BPL interests are also concerned about the proposed requirement that an interfering BPL device be turned off.<sup>82</sup> Some oppose the requirement as not warranted by actual field experience.<sup>83</sup> Others ask the Commission to clarify that this is a last resort to be invoked only

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<sup>80</sup> AT&T at 5-6; Southern LINC, Southern Telecom, Inc., and Southern Company Services, Inc. at 18-19.

<sup>81</sup> Two, for example, state that dynamic frequency selection cannot avoid interference to amateur signals that are too weak for BPL equipment to detect. ARRL at 21; Ray Soifer at 6. Another wants the Commission to require "marker beacons" carrying telemetry streams in BPL equipment for use in tracing interference. (Mr.) Tracy K. Wood at 4-5. Such beacons would be likely to create spectral lines that increase the potential for interference.

<sup>82</sup> Notice at para. 42.

<sup>83</sup> Ameren Energy Communications Inc. at 8-9; *see also* Southern LINC, Southern Telecom, Inc., and Southern Company Services, Inc. at 18.

after other mitigation measures have failed.<sup>84</sup> One asks that the shut-down requirement apply only to transmitter circuitry, not the receivers, so the device can be remotely re-activated without a truck roll.<sup>85</sup> Current Technologies concurs with the Commission that shut-down of the transmitter circuitry (only) can be required as a last resort, consistent with the general obligation under Part 15 for unlicensed emitters to mitigate harmful interference using whatever means the Part 15 operator chooses.<sup>86</sup> NTIA likewise sees shut-down as a last resort "after first attempting the many other interference mitigation techniques" available to BPL.<sup>87</sup>

### **3. *Notice to BPL customers***

Some parties want the Commission to require that BPL providers notify their customers in advance of possible service interruptions resulting from interference mitigation.<sup>88</sup> The request, which cannot possibly benefit interference victims, would only disadvantage BPL in the marketplace. Current Technologies opposes the proposal. Customer relations is the BPL provider's domain. A provider that must interrupt service to comply with the Commission's rules will do so whether or not its customers have advance notice. At least as to installations of Current Technologies' systems, we expect such instances will be rare.

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<sup>84</sup> *E.g.*, Consolidated Edison Co. of New York at 4, 6-7; United Power Line Council at 10; Duke Energy Corp. at 4 n.6.

<sup>85</sup> Duke Energy Corp. at 6-7.

<sup>86</sup> 47 C.F.R. Sec. 15.5.

<sup>87</sup> NTIA at viii.

<sup>88</sup> ARRL at 24; American Petroleum Institute at 11; Academy of Model Aeronautics at 6-7.

Moreover, customers using either BPL modems or unlicensed wireless networks for in-home distribution will have this FCC-mandated label on their equipment:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.<sup>89</sup>

This language will suffice to alert the user of possible "undesired operation."

#### **4. *Database considerations***

Some parties want the database of BPL installations to be publicly available, up-to-date, centralized for all BPL providers, and offering 24/7 contact information in all major languages.<sup>90</sup>

Some other parties oppose the database requirement altogether, claiming it is excessively burdensome.<sup>91</sup> Others oppose public access to the database.<sup>92</sup> Still others favor a limited centralized database showing only (1) whether Access BPL has been deployed in a particular zip

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<sup>89</sup> 47 C.F.R. Sec. 15.19(a)(3). If the device is very small, the label statement may appear in the instruction manual or on the device container. 47 C.F.R. Sec. 15.19(a)(5).

<sup>90</sup> ARRL at 23-24; Small Business in Telecommunications at 5-9; North American Shortwave Ass'n. at 5; (Mr.) Tracy K. Wood at 5.

<sup>91</sup> Power Line Communications Ass'n at 2-4; Ameren Energy Communications Inc, at 9-10 (proposed requirement is a holdover from present regulations that do not include adaptive interference mitigation requirements); PowerWAN, Inc. (pages unnumbered) (database is unnecessary because interference can always be easily localized to a particular BPL vendor and power company).

<sup>92</sup> Progress Energy, Inc. at 7; Cinergy Corp. at 3-4 (disclosure of map and other details of critical infrastructure raises security risk and competitive concerns, and invites meritless interference complaints); PPL Telcom, LLC at 7-8 (same); Duke Energy Corp. at 10-11; United Power line Council at 11-12; Southern LINC, Southern Telecom, Inc., and Southern Company Services, Inc. at 8-10; AT&T at 7.

code; (2) the BPL provider in that zip code; and (3) the provider's contact information.<sup>93</sup> Some suggest it is more efficient and less detrimental to competition for each provider to maintain its own database on its own website.<sup>94</sup>

One party, on the other hand, would greatly expand the scope of the database. NTIA wants the Commission to require each BPL system to post its technique for accessing multiple devices, specifics of the modulation scheme (including modulation type, carrier spacing parameters and data rate on each carrier), and the method of power control -- in short, a description of the BPL emission waveforms sufficient to enable identification using a spectrum analyzer.<sup>95</sup> NTIA also proposes that the database list the maximum number of BPL devices to be deployed in the area, updated quarterly, as an assist to NTIA in its planned studies of ambient radio noise due to ionospheric propagation and aggregation of BPL emissions.<sup>96</sup> And it seeks to have all of this information filed 30 days in advance of BPL deployment.<sup>97</sup>

The burden of complying with these proposals would be far out of proportion to any benefit. Identifying the BPL provider responsible for a given interference incident will rarely be a problem, given a maximum potential interference range of just a few tens of meters, and only one BPL provider in a given area. Providing and updating installation numbers on an ongoing

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<sup>93</sup> Duke Energy Corp. at 10. *See also* Main.net Communications Ltd. at 7-8 (similar); Southern LINC, Southern Telecom, Inc., and Southern Company Services, Inc. at 10-12 (similar).

<sup>94</sup> Sprint Corp. at 4; Progress Energy, Inc. at 7.

<sup>95</sup> NTIA at 12.

<sup>96</sup> NTIA at 12.

<sup>97</sup> NTIA at 10-11.

basis will be onerous. If NTIA wants to do noise studies at some time in the future, it can request then-current information from BPL providers in the particular areas it wants to study. Moreover, the 30-day advance notice requirement would competitively disadvantage BPL relative to other broadband providers, which are not obliged to disclose their installations in advance -- or even after the fact.

Current Technologies' proposal for placing a comprehensive database with a trusted, technically qualified third party is a practical and responsible way to accommodate all of these competing interests.<sup>98</sup> A licensed user claiming interference can have its complaint investigated promptly by a knowledgeable party having access to full information about local BPL deployment, without the need for public disclosure of that information. The entity selected for this role will need the confidence of both the BPL industry and the communities of licensed spectrum users, and should have experience in operating comparable databases and in interference analysis.

## **5. *No advance coordination***

NTIA proposes *a priori* coordination of BPL systems at locations near potentially affected receiving stations.<sup>99</sup> Aeronautical Radio, Inc. (ARINC) likewise seeks a requirement that BPL providers coordinate with ARINC within 15 miles of eight fixed ARINC receive sites.<sup>100</sup>

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<sup>98</sup> Current Technologies, LLC at 18-23. *Accord*, National Rural Telecommunications Cooperative and National Rural Electric Cooperative Ass'n at 6; Hawaiian Electric Co. at 4-5.

<sup>99</sup> NTIA at 9.

<sup>100</sup> Aeronautical Radio, Inc. at 6-7.



In its most general form, NTIA's request is impractical. NTIA itself notes 59,000 federal Government frequency assignments over the 1.7-80 MHz range,<sup>101</sup> and that number must be dwarfed by private licenses over the same frequency range. Moreover, NTIA concedes a mobile receiver operating via ionospheric signal propagation can be located virtually anywhere relative to the stations it communicates with,<sup>102</sup> setting up a case for possibly having to coordinate mobile frequencies everywhere. But that is unnecessary. Considering that properly designed BPL systems will operate at Part 15 levels, and will cause no more interference than conventional digital devices, a coordination requirement is unwarranted as to both the vast majority of NTIA's 59,000 assignments and to ARINC's operations. There may be a few truly exceptional instances, such as locations very close to co-frequency radio astronomy receive sites, where coordination could be appropriate, but the minuscule levels of BPL emissions should make this an extremely rare exception.

**E. NTIA's Proposed Interference Prevention Measures are Unnecessary.**

NTIA proposes a wide variety of measures to prevent interference from BPL, in addition to those discussed elsewhere.<sup>103</sup> It requests coordination areas, excluded bands, and exclusion

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<sup>101</sup> NTIA Phase I Study at v.

<sup>102</sup> NTIA at 10 n.19.

<sup>103</sup> Those other measures include immediate testing on receipt of an interference complaint; exhaustive information in the database; advance notification; advance coordination at some sites; power reductions in the measurement procedures; and certification of BPL devices by the BPL provider.

zones (without having yet put forward the specifics);<sup>104</sup> adaptive power control;<sup>105</sup> preclusion of BPL operation on local frequencies close to potential receive sites, including mobile receivers;<sup>106</sup> and several categories of frequency agility and accommodation.<sup>107</sup> NTIA also mentions a possible proposed requirement for BPL systems to transmit identifying codes as a means to help determine whether a given interference incident is BPL related.<sup>108</sup>

These recommendations rest on NTIA's belief that BPL devices pose interference risks that are "among the highest of the various kinds of authorized, unlicensed devices."<sup>109</sup> As we have shown above, with respect to BPL generally and as to Current Technologies' implementation in particular, that assertion is incorrect. A Current Technologies system consists solely of Part 15 unintentional emitters, configured so that very few in a multi-block area can operate at a time. These require no more in the way of protective measures than any other

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<sup>104</sup> NTIA at 7-8.

<sup>105</sup> NTIA at 8.

<sup>106</sup> NTIA at 8.

<sup>107</sup> Specifically, BPL systems would have to be capable of locking out BPL transmissions in bands of at least 3 kHz at frequencies below 30 MHz and 30 kHz at frequencies above 30 MHz, and of using frequencies anywhere in the frequency range authorized for BPL, on the ground that some locations may require many BPL frequency constraints. NTIA at 10. Geographically adjacent Access BPL network elements would be not allowed to use the same frequency bands if the bands are used by mobile radio receivers, to avoid potentially impairing mobile communications over sizable contiguous areas. NTIA at 10. BPL operators should have to extract local frequency assignment data from the pertinent Commission databases, identify the locations and frequencies used by local radio receivers, and plan BPL operating frequencies in a manner that avoids BPL interference to local co-frequency radio receivers, and also avoid frequencies specified by NTIA in response to BPL prior notifications. NTIA at 11.

<sup>108</sup> NTIA at 12.

<sup>109</sup> NTIA at 14.

Part 15 devices. NTIA's proposals would thus serve no useful purpose. Yet each of the proposed measures would either impede BPL's to reach an adequate number of households with satisfactory data speeds or tend to render the service economically infeasible.

We also noted above that several assumptions render the conclusions drawn from NTIA's studies inapplicable to Current Technologies' system.<sup>110</sup> In particular, Current Technologies' medium-voltage devices operate only in the 30-50 MHz range. We understand NTIA does not believe that use of those frequencies for BPL poses a serious interference threat. Our own experience points to the same result. Most of the Government (and non-Government) equipment in this band consists of two-way mobile radios. Current Technologies has carried out repeated interference studies using two-way communications equipment at these frequencies. We consistently find that the radios, even operating at the very limit of their maximum range, are completely unaffected by BPL, even with a co-frequency BPL device operating on a pole directly overhead.

Taken individually, some of these measures suggested by NTIA might be appropriate *if BPL were a proven major interference threat*. But on the present record, including NTIA's own studies, that is not the case. The application of NTIA's proposed measures would constitute significant excess.<sup>111</sup>

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<sup>110</sup> See Part C.7.

<sup>111</sup> Some also seem impractical. The notion of an ID code embedded in the BPL signal, NTIA at 12, would require either adding tones to the otherwise noise-like signal, which greatly increases the risk of interference, or amplitude-modulating the entire noise signal in a pattern using Morse code (or something similar). The pattern would have to be transmitted slowly, to avoid spectral artifacts associated with sudden amplitude changes. But a typical transmission from Current Technologies' equipment lasts well under a millisecond, which does not allow time to encode a message.

NTIA correctly points out that the Commission's rules can be revisited later if they are found to be inadequate.<sup>112</sup> We are confident that properly designed BPL systems compliant with the Part 15 limits, combined with a database and the Commission's proposed mitigation requirements, will avoid harmful interference to licensed services. In the unlikely event that early deployments show additional precautions are needed, the Commission need not hesitate to impose them.

**F. The Commission Need Not Regulate Interference *Into* BPL.**

Some parties, in cataloguing reasons the Commission should prohibit BPL deployments, include a claim that radio-frequency energy from licensed services will cause interference into BPL and disrupt service to BPL subscribers.<sup>113</sup>

Whether or not such interference is possible in principle, it should not occur in ordinary practice. It certainly has not impeded service to date. Even if it affected operations, however, interference into BPL would have no regulatory significance. BPL devices are subject to Section 15.5(b) of the Commission's Rules, which provides (in pertinent part): "[I]nterference must be accepted that may be caused by the operation of an authorized radio station . . . ."<sup>114</sup> To our knowledge, the Commission has never entertained a Part 15 user's interference complaint. Current Technologies incorporates extensive filtering in its receive chains to block incoming

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<sup>112</sup> NTIA at 25-26.

<sup>113</sup> ARRL at 26; Amateur Radio Research and Development Corp.; IEEE-USA at para. 13; Carl R. Stevenson at para. 13; Glenn W. Pelikan at 2-3.

<sup>114</sup> 47 C.F.R. Sec. 15.5(b).

interference. But any interference that gets through is our problem. Like other BPL providers, Current Technologies has no recourse at the Commission.

We note one exception. A BPL provider would be justified in proceeding in an appropriate forum against an operator who, making no serious effort to effect communications, misuses his or her facilities to intentionally or maliciously interfere with BPL operations.<sup>115</sup>

**G. The Commission Should Adopt Its Proposed Technical Rules.**

**1. Emissions limits**

In a refreshing show of unanimity, virtually all parties commenting on the issue agree the Part 15 limits are appropriate to BPL, at least as a starting point.<sup>116</sup> (To be sure, some specify the Part 15 limits *would* be appropriate if Part 15 devices were point-source emitters<sup>117</sup> -- as Current Technologies' devices are.) Only a few parties propose other limitations: retaining conducted limits on low-voltage devices;<sup>118</sup> requiring 80 dB attenuation below 535 kHz to protect non-BPL carrier current systems;<sup>119</sup> notching certain radio astronomy and Government frequencies;<sup>120</sup> and requiring low-voltage and medium-voltage wiring to be separated by at least 18 inches to prevent

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<sup>115</sup> See 47 C.F.R. Sec. 97.101(a).

<sup>116</sup> E.g., Consumer Electronics Ass'n at 4-5; Hawaiian Electric Co. at 3; Nextnet Telecom, LLC at 2; PPL Telcom, LLC at 4; Main.net Communications Ltd. at 5-6; Duke Energy Corp. at 13; United Power line Council at 5-6; Southern LINC, Southern Telecom, Inc., and Southern Company Services, Inc. at 15-17.

<sup>117</sup> E.g., ARRL at 2-3, 5, 9-10; Aeronautical Radio, Inc. at 7-9; Academy of Model Aeronautics. at 4.

<sup>118</sup> Consumer Electronics Ass'n at 6.

<sup>119</sup> Echelon Corp. at 5.

<sup>120</sup> National Academy of Sciences' Committee on Radio Frequencies at 4-5, 7; NTIA at 7-8.

inductive coupling.<sup>121</sup> Each of these would ultimately add to the cost of BPL service, and none is necessary. The present Part 15 limits have successfully protected licensed services from digital emissions for a quarter century, even though both licensed and digital equipment have evolved dramatically over that time. No party here has presented data that would justify a change to the regime.

## **2. *Measurement Procedures***

Most commenters support on-site testing of representative installations.<sup>122</sup> Two parties, claiming that device performance depends on environment, propose that each *individual* BPL device be tested on site.<sup>123</sup> This proposal, if adopted, would price BPL service out of the market without any concomitant benefit. There is no showing that the proposed requirement for six representative test sites -- twice the number required for on-site measurements of other equipment<sup>124</sup> -- is inadequate to characterize BPL devices.

NTIA proposes two modifications to the measurement procedures. First, in place of the Commission's proposed measurements at specified fractional wavelengths down the line from the BPL device,<sup>125</sup> NTIA suggests "a comprehensive search for the overall peak field strength . . .

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<sup>121</sup> Echelon Corp. at 5.

<sup>122</sup> United Power Line Council at 13; Main.net Communications Ltd. at 8-8; Hawaiian Electric Co. at 3; Southern LINC, Southern Telecom, Inc., and Southern Company Services, Inc. at 20-21.

<sup>123</sup> American Petroleum Institute at 9-10; Ronald K. Wray at 19-20.

<sup>124</sup> 47 C.F.R. Sec. 15.31(d).

<sup>125</sup> Notice at Appendix C, para. 2.b.2.

along key segments of the power line."<sup>126</sup> While we agree a suitable procedure should search for peak emissions, manufacturers need some guidance on how dense the search grid should be, and how far out it should extend. The Commission's technique answers those questions. We are receptive to proposed changes that may better locate the peak, but we think specific procedures are needed to forestall abuse by careless or economy-minded manufacturers. Second, rather than measure emissions at heights of 1-4 meters, as the Commission proposes, NTIA suggests measurement at a uniform one-meter height together with the uniform application of a 5 dB "height correction factor."<sup>127</sup> Our own studies show the 5 dB "correction" can result in an overestimation of the actual emissions. The Commission should stay with its original proposal.<sup>128</sup>

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<sup>126</sup> NTIA at 19.

<sup>127</sup> NTIA at 19-21.

<sup>128</sup> For the future, the Commission should propose and adopt two changes governing compliance measurement. First, the rules should give a BPL manufacturer the option of testing radiated emissions over the 30-50 MHz range with a 25 kHz measurement bandwidth, in place of the 100 kHz bandwidth now required. The narrower bandwidth yields a better prediction of interference potential to victim receivers in this band, and it helps to isolate ambient signals from licensed transmitters that otherwise contaminate the measurement. Second, the Commission should permit BPL compliance testing of radiated emissions in the 30-50 MHz band with average detector settings rather than quasi-peak settings. Quasi-peak is designed primarily to measure the aural impact of interference on AM receivers. But receivers in the 30-50 MHz band are FM, so that average emissions are at least as good a predictor of interference. And they have an important advantage, relative to quasi-peak detectors, of reducing the response to extraneous power line noise during *in situ* testing.

### 3. *Equipment authorization procedures*

The large majority of parties commenting on the issue support verification of BPL devices.<sup>129</sup> Two parties request certification.<sup>130</sup> With very few exceptions, however, the Commission requires certification only for mobile and consumer products. Nearly all fixed devices that must be professionally installed, like BPL equipment, are subject to verification. No party has presented any reason to believe BPL manufacturers will neglect their obligations under the verification procedure. A certification requirement would unnecessarily increase the cost of BPL equipment, and would discourage innovation by interposing cost and delay in technical improvements.<sup>131</sup>

NTIA would go a step farther, and have BPL equipment certified to the BPL operator, rather than the manufacturer.<sup>132</sup> NTIA explains its position with a claim that BPL devices pose "relatively high interference risks,"<sup>133</sup> which we have shown is not the case. Moreover, a provider cannot rationally assume responsibility for products over whose manufacture it has no control. For example, a certification grantee warrants that each unit marketed conforms to the unit tested for certification.<sup>134</sup> A provider, purchasing equipment from a vendor, cannot make

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<sup>129</sup> *E.g.*, Duke Energy Corp. at 13-14; Hawaiian Electric Co. at 5; HomePlug Powerline Alliance at 5-6; PPL Telcom, LLC at 8; Main.net Communications Ltd. at 8; Ameren Energy Communications Inc, at 10; PowerWAN, Inc. (pages unnumbered); United Power Line Council at 13.

<sup>130</sup> Academy of Model Aeronautics at 9; NTIA at 14-15.

<sup>131</sup> *See* 47 C.F.R. Sec. 2.1043.

<sup>132</sup> NTIA at 14-15.

<sup>133</sup> NTIA at 15.

<sup>134</sup> 47 C.F.R. Sec. 2.931.



that representation of its own knowledge, and so should not be asked to take on the obligations of a grantee. At the same time, however, the provider remains fully responsible for any interference a non-compliant device may cause.

**H. The Commission Should Not Regulate the Ownership of BPL Systems.**

One commenter, citing safety and reliability issues, asks for a rule that all Access BPL equipment be installed, owned, and/or operated by the electric utility or its affiliate, and that all installation of equipment coupled directly onto energized power lines or attachments in the electric supply space be performed only by utility crews and/or utility approved contractors.<sup>135</sup> While sympathetic to the same safety and reliability concerns, we think the proposed remedy is unnecessary and overly intrusive, and possibly outside the Commission's jurisdiction.

The host utility has full control over the power lines on which BPL operates. And the utility is subject to the full panoply of both state and federal regulation as to safety and reliability. Taken together, these considerations ensure the utility will adequately supervise the installation and operation of BPL equipment. A utility may choose to provide BPL itself or through an affiliate, or it may opt to partner with an independent entity. That decision should rest with the utility. Either way, the utility still must answer to the FERC and the state PUC for the integrity of its power operations, notwithstanding the attachment of BPL equipment, and must also ensure compliance with the National Electric Safety Code (NESC) and other applicable safety standards and guidelines applicable to BPL equipment installation. Most utilities and states, as well as the NESC and the Occupational Safety & Health Administration, already require that installations on

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<sup>135</sup> Southern LINC, Southern Telecom, Inc., and Southern Company Services, Inc. at 14.

energized electric distribution wires be installed only by qualified utility personnel or qualified, utility-approved contractors.<sup>136</sup> Regulation of these arrangements by this Commission, even if lawful, would be superfluous.

**I. Issues of Regulatory Jurisdiction and Service Regulation Are Outside the Scope of this Proceeding.**

Several parties request rules that go not to BPL itself, but to services that may be delivered via BPL, as follows:

- BPL should be declared a "telecommunications service" subject to complaint procedures under Section 208 of the Communications Act.<sup>137</sup>
- BPL providers should be deemed "telecommunications carriers" subject to CALEA.<sup>138</sup>
- The Commission should deregulate the Bell Operating Companies so as to achieve nondiscriminatory broadband competition.<sup>139</sup>
- States should have jurisdiction over telecommunications services offered via BPL.<sup>140</sup>
- The Commission should enter into individualized consultations with Indian tribes and give the tribes control over BPL deployment.<sup>141</sup>
- The Commission should address major policy issues related to BPL such as easements, rights-of-way, pole attachment rules, state enabling acts,

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<sup>136</sup> See National Electric Safety Code, Sections 410A, 420B; 29 C.F.R. Sec. 1910.296 (OSHA standard).

<sup>137</sup> Small Business in Telecommunications at 14-17.

<sup>138</sup> U.S. Dept. of Justice at 5-6.

<sup>139</sup> BellSouth at 1-3.

<sup>140</sup> California Public Utilities Commission, Reply Comments at 5.

<sup>141</sup> Cheyenne River Sioux Tribe Telephone Authority at 6-12.

E911 requirements, and definitions of telecommunications and information services.<sup>142</sup>

- The Commission should monitor cable pole attachments for anti-competitive behavior.<sup>143</sup>

The answer to each of these filings is the same. BPL is a technology, not a service. This proceeding addresses the technical regulation of BPL equipment with the goal of preventing and, if necessary, mitigating radio-frequency interference to radio communications. The issues raised above go to a different category of concerns, relating not to BPL itself, but to services that may eventually be carried over BPL. Some of these are under discussion in the Commission's ongoing proceeding on Internet-protocol enabled services.<sup>144</sup> Others can be raised in appropriate policy-oriented proceedings. But for the Commission to rule on these issues now would exceed the scope of the present Notice, and hence violate the Administrative Procedure Act.<sup>145</sup> Even a Further Notice on telephone-related regulatory issues, as requested by the National Telecommunications Cooperative Association, would be inappropriate. A shift in subject matter from Title III technical limits and measurement procedures to Title II regulatory and jurisdictional issues calls for a new docket.

One jurisdictional argument takes a different answer. A party claims that the 60 Hz "baseband" used for BPL transmission is below the 9,000 Hz lower limit of Commission

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<sup>142</sup> National Rural Telecommunications Cooperative and National Rural Electric Cooperative Ass'n at 7.

<sup>143</sup> National Cable & Telecommunications Ass'n at 6-7.

<sup>144</sup> *IP-Enabled Services*, 19 FCC Rcd 4863 (2004).

<sup>145</sup> 5 U.S.C. Sec. 553(b).

jurisdiction,<sup>146</sup> and on that basis asserts that jurisdiction over BPL rests with the Federal Energy Regulatory Commission rather than this Commission.<sup>147</sup> The contention is misplaced. The 60 Hz used for power distribution is neither a BPL baseband frequency nor a carrier frequency. This Commission has full jurisdiction over BPL devices to the extent that they emit radiation at frequencies above 9,000 Hz, as they unquestionably do.

### **CONCLUSION**

If implemented under the proposed rules, with the adjustments Current Technologies suggested in its first-round comments, BPL can deliver important benefits with no significant risk of interference to other services, and with assurance that any interference that does occur will be promptly investigated and corrected. We urge the Commission to adopt such rules at the earliest possible date.

Respectfully submitted,

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<sup>146</sup> 47 C.F.R. Sec. 2.102(a).

<sup>147</sup> National Energy Marketers Ass'n.

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